NOTES ON NORTH AMERICAN WILLOWS. III

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The first[1] of a projected series of papers under this title was published in this journal in November 1905. Since that date, the writer's contributions on Salices have been confined to treatment of the genus for two floras covering widely different sections of the country, namely, the Rocky Mountains[2] and the Central Atlantic states.[3] In the ten-year period, however, thousands of specimens have been determined for collectors and herbaria, extensive field studies and collections have been made, and a considerable fund of data accumulated, some of which are presented in the third paper[4] of this series and in the following paragraphs.

1. The willows of the Black Hills

The first list of the plants of this district, of which the writer has knowledge, was published by RYDBERG[5] in 1896. He collected at some 20 points in the Black Hills, during the period from May 27 to August 18, 1892, visiting some places twice. Four species of *Salix* are recorded (p. 523): *S. fluviatilis* Nutt., *S. cordata* Muhl., *S. discolor* Muhl., and *S. Bebbiana* Sarg. Of these, *S. fluviatilis* is listed only from Rochford; *S. cordata* only from Custer and Lead; *S. discolor* only from Custer; while *S. Bebbiana* was collected at 5 points. No data on frequency of occurrence are given for the willows, though such notes are given commonly throughout the paper. It is probable, however, that the three species first named were met with at points other than where collections were made.

[1] BALL, CARLETON R., Notes on North American willows. I. BOT. GAZ. **40**:376–380. *pls. 12, 13.* 1905.

[2] ———, *Salix* in COULTER and NELSON, New Manual Rocky Mt. Bot. pp. 128–139. 1909.

[3] ———, *Salix* in TIDESTROM, Elysium Marianum **3**:19–37. *pls. 4–9.* 1910.

[4] ———, Notes on North American willows. II. BOT. GAZ. **60**:45–54. *figs. 3.* 1915.

[5] RYDBERG, P. A., Flora of the Black Hills of South Dakota. Contrib. U.S. Nat. Herb. **3**:463–536. 1896.

While the Black Hills have always been recognized as belonging to the Rocky Mountain system, and as having a flora allied to that of the Rocky Mountain region, it will be noted that the four willows reported by RYDBERG are all eastern species. They range from the North Atlantic and the New England states westward across the great interior valley. *S. Bebbiana* extends commonly and *S. fluviatilis* less commonly into the Rocky Mountain region itself, but primarily they are eastern species. The question of the identification of the specimens collected is not raised at this point.

Another list which includes the Black Hills district was published by WILLIAMS,[6] presumably in 1895. The willows of the state, 10 in number, include the 4 of RYDBERG'S Black Hills list and also 3 others credited to the Black Hills. It does not appear from this publication that herbarium specimens of all the species were obtained. WILLIAMS refers frequently to RYDBERG'S collections from the Black Hills and was doubtless familiar with a manuscript copy of his list. The 3 additional species credited to the Black Hills are as follows:

"18. YELLOW WILLOW (*Salix flavescens* Nutt.).—A shrub found in the Black Hills. It may be recognized by the nearly entire leaves which are downy, or smooth and dull green above, and pale with a rufous pubescence beneath" (p. 106). No reference is made to any collections.

"19. HAIRY WILLOW (*Salix glauca villosa* Anders.).—. . . . Found at various places in the Black Hills and on the Yellow Bank in Grant County" (p. 106).

"20. PRAIRIE WILLOW (*Salix humilis* Marsh.).—A small shrub reported from the Black Hills by Mr. RYDBERG" (p. 107). In no case is herbarium material cited. Again the question of identification is waived for the time.

A third list covering the territory of the Black Hills in South Dakota was published by SAUNDERS.[7] The striking thing about this list is that it does not include two of the three additional willows credited to the Black Hills by WILLIAMS, namely, *S. flavescens* and *S. glauca villosa*. It does list *S. humilis*, but as occurring only

[6] WILLIAMS, T. A., Native trees and shrubs. S.D. Exper. Sta. Bull. 43. 1895 (pp. 105–107).

[7] SAUNDERS, D. A., Ferns and flowering plants of South Dakota. S.D. Exper. Sta. Bull. 64. 1899 (pp. 134, 135).

in the eastern part of the state. The reasons for omitting these three willows can be guessed only. Either specimens were not found in the herbaria examined or they proved to belong to other species than those listed. It is a fair guess that *S. humilis* was included by WILLIAMS on the strength of RYDBERG'S[8] identification of his no. 1019 from Rochford, of which he says:

> A few specimens with thick leaves as in *S. humilis* and *S. tristis* were collected at Rochford, altitude 1700 m., July 12. Even these have been referred to *S. rostrata* by Mr. BEBB (no. 1019).

At any rate, the list of Black Hills willows was again reduced to four species. So far as publications are concerned, the number seems still to rest there, though in 1912 PERISHO and VISHER[9] reported *Salix lutea*, a western species, as being "fairly common along brooks" in Washington County, which adjoins the Black Hills on the southeast.

On September 19, 1908, the writer studied and collected the willows occurring along Whitewood Creek from the railroad station upstream for a mile or more. Five species were found. Two of them, *S. lutea* Nutt. and *S. prinoides* Pursh, were very common in the floodplain of the stream. Of each of the remaining three, *S. Fendleriana* Anderss., *S. Scouleriana* Barr., and *S. Bebbiana* Sarg., only a single plant was found. All three were obtained in the edge of the city. An examination of RYDBERG'S specimens showed that *S. lutea* was the species reported as *S. cordata* by him, while *S. prinoides* was the basis of his record for *S. discolor*. The finding of *S. Scouleriana* bears out the statement quoted from WILLIAMS under *S. flavescens*, which is a synonym. This is the first recorded collection of *S. Fendleriana* in the Black Hills. It occurs commonly in the canyons of the Rocky Mountains and westward at elevations of 5000 feet and over. The number of species was now increased to six.

Collections of *S. amygdaloides*, *S. fluviatilis*, and *S. cordata* were made also at Bellefourche on the same date, but as Belle-

[8] *Op. cit.*, p. 523.

[9] PERISHO, E. C., and VISHER, S. S., The geography, geology, and biology of south central South Dakota. State Geol. and Biol. Survey Bull. 5. p. 90. 1912.

fourche properly is not in the Black Hills, *S. amygdaloides* is not added.

On September 14, 1910, the writer again visited Deadwood for a short time and studied the willows found on the northern flank of the White Rocks, principally around a spring lying just below the wagon road. Here *S. Bebbiana* and *S. prinoides* were found abundantly and *S. lutea* less commonly on the seepy slope below the spring. Two or three stunted plants of *S. Scouleriana* occurred in dry ground just across the road above the spring.

On August 23, 1913, the writer collected *S. lutea* at the railroad station at Mystic, and *S. Bebbiana* and *S. Scouleriana* again at the spring north of the White Rocks at Deadwood. All these collections are cited under the respective species at the end of this article.[10]

In the spring and summer of 1910, Mr. JOHN MURDOCH, JR., of the United States Forest Service, collected an extensive series of specimens in various parts of the Black Hills. A portion of the series was sent to the writer for identification through the United States Forest Service, on April 1, 1913. Seventeen numbers were flowering specimens of *S. prinoides* and *S. Bebbiana*, one was *S. fluviatilis*, and one proved to be a young pistillate specimen of *S. Nelsonii* Ball, a rather rare member of § PHYLICIFOLIAE, known previously from the mountains of Colorado and Wyoming. A more complete set from the private herbarium of the collector was submitted to the writer by Dr. GEO. B. SUDWORTH, dendrologist of the Forest Service, on January 14, 1915. It was found to contain, besides numerous specimens of *S. prinoides* and *S. Bebbiana*, the specimen of *S. Nelsonii* (no. 4039) mentioned above, collected at Redfern Plantation no. 2, and also a specimen bearing mature foliage (no. 4233), collected at the same place in July.

[10] Since this paper was prepared, the writer has seen a series of short papers by VISHER, entitled Additions to the flora of the Black Hills of South Dakota (Torreya **9**:186–188. 1909; Muhlenbergia **8**:135–137. 1913; *ibid.* **9**:33–39. 1913). In the first paper he records *S. Scouleriana* as "Frequent, forming trees, in deep woods, well up on Custer's Peak." The collection was made in August 1908, just a month before it was collected by the writer at Deadwood.

In one of another series of papers (Additions to the flora of South Dakota. II. Muhlenbergia **9**:69–77. 1913) VISHER reports *S. Fendleriana* as "Common in boggy soil in the forest reserves and along the Little Missouri River" of Harding County, north of the Black Hills, in the northwest corner of the state.

There was also one specimen each of *S. amygdaloides* and *S. lutea*. Very interesting also were a specimen of *S. Fendleriana* (no. 4375), with mature foliage, from Rochford; three foliage specimens of *S. Scouleriana*, also from Redfern Plantation no. 2; a foliage specimen of *S. Geyeriana* (no. 4367) from Bear Butte Creek; and finally a single collection of what is probably *S. monticola* Bebb (no. 4374) from South Rapid Creek, at an elevation of 6100 feet. By this collection four species, *S. amygdaloides*, *S. Geyeriana*, *S. monticola*, and *S. Nelsonii*, not previously reported, were added to the flora of the Black Hills. All except the first are strictly plants of the western mountains. The specimen identified as *S. monticola*, which consists of autumn-colored foliage collected September 16, is certainly not referable to either *S. cordata* or *S. lutea*, and with equal certainty is a species not previously recorded for the Black Hills. Two of the sheets of *S. Scouleriana* show only small but mature leaves, suggesting a dwarfed habit, and the data indicate that they come from dry situations.

In the early spring of 1913, some fragmentary specimens collected in 1912 by Messrs. T. C. SETZER and N. E. PETERSEN, of the Merritt Ranger Station in the Black Hills Forest Reserve, were sent the writer for identification. On examination these were found to include such Rocky Mountain species as *S. glaucops* Anderss., *S. chlorophylla* Anderss., *S. Nelsonii* Ball, and *S. Geyeriana* Anderss. Of these, the first two had not been collected previously in the Black Hills. At the request of the writer, Mr. W. H. LAMB, of the Forest Service, kindly made immediate arrangements to have better material collected in 1913. As a result, there were received for identification, on January 21, 1914, another series of these same species. Careful examination confirmed the previous determinations and hence added two more species to the list of those known to be native to the Black Hills. This list now contains 12 species, all native. Three out of the 12, namely, *S. amygdaloides*, *S. fluviatilis*, and *S. Bebbiana*, are found nearly across the continent. One, *S. prinoides*, is an eastern species finding here nearly the western limit of its range. The 8 others are habitants of the Rocky Mountains and westward, which find the eastern limits of their ranges in the Black Hills.

KEY TO THE SPECIES

Capsule glabrous
  Scales yellow
    Leaves large, lanceolate, serrate; stamens 3–5
      Leaves glaucous beneath ..... 1. *S. amygdaloides.*
      Leaves green beneath ..... 2. *S. Fendleriana.*
    Leaves linear; stamens 2
      Leaves green beneath, remotely denticulate ..... 3. *S. fluviatilis.*
  Scales brownish to black
    Aments short-peduncled; twigs yellow; style less than 0.5 mm. 4. *S. lutea.*
    Aments sessile; twigs reddish; style 1 mm. or over ..... 5. *S. monticola.*
Capsule hairy
  Style long; scales usually black, pilose
    Aments peduncled; leaves gray pubescent above ..... 6. *S. glaucops.*
    Aments sessile; leaves bright green above, glabrous
      Leaves broadly elliptical or oval ..... 7. *S. chlorophylla.*
      Leaves narrowly elliptical ..... 8. *S. Nelsonii.*
  Style short or none
    Scales obovate, black, pilose; aments sessile
      Leaves elliptical, undulate-crenate, glabrous ..... 9. *S. prinoides.*
      Leaves obovate, entire, often pubescent beneath ... 10. *S. Scouleriana.*
    Scales linear-oblong, yellow or the tip dark; aments short-pedunculate
      Leaves elliptic-obovate; pedicels long ..... 11. *S. Bebbiana.*
      Leaves linear-oblanceolate; pedicels short ..... 12. *S. Geyeriana.*

SPECIMENS EXAMINED

The following specimens have been examined by the writer. Their present location in herbaria, so far as known, is indicated by the letters following the collection numbers. The key to these letters is: B, Herb. C. R. BALL; C, Herb. Canada Geol. Survey; F, Herb. U.S. Forest Service; G, Gray Herbarium; I, Herb. Iowa State College; M, Herb. JOHN MURDOCH, Jr.; N, U.S. National Herbarium; R, Rocky Mountain Herbarium.

1. *Salix amygdaloides* Anderss.

BELLEFOURCHE.—Floodplain of Bellefourche River, *Ball* (1341, B, C, N, R) 1908; (1697, B; 1699, B) 1910.

DEADWOOD.—Whitewood Creek below Smelter, alt. 1370 m., *Murdoch* (4322, M) 1910.

2. *S. Fendleriana* Anderss.

DEADWOOD.—Bank of Whitewood Creek, south edge of town, alt. about 1400 m., *Ball* (1356, B, N, R) 1908.

ROCHFORD.—Alt. 1585 m., *Murdoch* (4375, M) 1910.

3. *S. fluviatilis* Nutt.

BELLEFOURCHE.—Floodplain of the Bellefourche River, *Ball* (1340, B, C, N, R; 1344, B, N) 1908; (1696, B, N, R) 1910.

ROCHFORD.—Alt. 1675 m., *Rydberg* (1020, N) July 11, 1892.

SAVOY.—Creek banks, alt. 1525 m., *Murdoch* (4166, F, M) 1910.

4. *S. lutea* Nutt.

BELLEFOURCHE.—Floodplain of Bellefourche River, *Ball* (1694, B, N; 1695, B, C, N, R), foliage, 1910.

CUSTER.—Alt. 1690 m., *Rydberg* (1015, N) June 4, 1892.

DEADWOOD.—Floodplain of Whitewood Creek, alt. about 1400 m., *Ball* (1352, B, C, G, N, R; 1354, B), foliage, 1908; spring below White Rock, alt. about 1460 m., *Ball*, 1686, B, C, I, N, R), foliage, 1910.

FT. MEADE.—*Forwood*, flowers, May 1, 1887.

LEAD.—Alt. 1675 m., *Rydberg* (1017, N), foliage, July 7, 1892.

MYSTIC.—At railroad station, alt. 1460 m., *Ball* (1827, B, N), foliage, 1913.

REDFERN.—Plantation No. 2, alt. 1675 m., *Murdoch* (4038, M), pistillate flowers, May 13, 1910.

STURGIS.—Alt. 1065 m., *Carr* (344, B; 345, B), staminate and pistillate flowers, May 17, 1912.

5. *S. monticola*(*?*) Bebb

SOUTH RAPID CREEK.—Alt. 1860 m., *Murdoch* (4374, M), foliage, September 16, 1910.

6. *S. glaucops* Anderss.

MERRITT.—Ranger Station, headwaters of Jim Creek, Sec. 8, Tp. 2 N., Range 5 E., alt. about 1525 m., *Setzer* (F) 1912; *Setzer* (2, B), staminate, May 6, 1913.

7. *S. chlorophylla* Anderss.

MERRITT.—Ranger Station, headwaters of Jim Creek, Sec. 8, Tp. 2 N., R. 5 E., alt. 1525 m., *Setzer* (F) 1912; *Setzer* (1, B), staminate, May 6, and foliage, June 2, 1913.

8. *S. Nelsonii* Ball

MERRITT.—Ranger Station, headwaters of Jim Creek, Sec. 8, Tp. 2 N., R. 5 E., alt. 1525 m., *Setzer* (F) 1912; *Setzer* (3, B), pistillate, May 6, and foliage, June 2, 1913.

REDFERN.—Plantation no. 2, alt. 1710 m., *Murdoch* (4039, B, M), pistillate, May 13, 1910; *Murdoch* (4233, M), foliage, July 13, 1910.

9. *S. prinoides* Pursh

BEAR BUTTE CREEK and vicinity.—Mostly 6–8 miles southeast from Deadwood, and about the same distance northeast from Custer Peak; alt. 1525–1650 m., *Murdoch* (4002–4015 inclusive, F, M), staminate and pistillate flowers, April 7–10, 1910; (4366, 4369, both M), foliage, September 8, 1910.

CUSTER.—Alt. 1675 m., *Rydberg* (1014, N), staminate and pistillate flowers, May 31, 1892.

CUSTER PEAK.—About 3 miles E., alt. 1710 m., *Murdoch* (4001, F, M) staminate flowers, April 7, 1910.

DEADWOOD.—Floodplain of Whitewood Creek, alt. about 1400 m., *Ball* (1349, B, N, R; 1353, B, C, G, N, R; 1355, B, N, R), foliage, 1908; at spring north of White Rock, alt. about 1460 m., *Ball* (1681, B, N, R; 1684 and 1685, B, C, I, N, R), foliage, 1910.

DUMONT.—Alluvium, Thompson's Bridge, alt. 1830 m., *Murdoch* (4267, M), foliage, August 4, 1910.

STURGIS.—*Carr* (308, B), flowers, May 17, 1912.

10. *S. Scouleriana* Barratt

DEADWOOD.—Bank of Whitewood Creek, alt. about 1400 m., *Ball* (1350, B, C, G, N, R), foliage, 1908; at spring below White Rock, alt. about 1460 m., *Ball* (1683 and 1687, B, C, I, N, R), foliage, 1910, (1832 and 1833, B, N), foliage, 1913.

REDFERN.—Plantation no. 2, alt. 1740 m., *Murdoch* (4220, 4221, 4237, all M), foliage, July 13, 1910.

11. *S. Bebbiana* Sargent

BEAR BUTTE CREEK.—About 5–8 miles S.E. of Deadwood, alt. 1555 m. *Murdoch* (4010, in part, and 4022*a*, F, M), flowers, April 10–27, 1910; (4368, M), foliage, September 8, 1910.

CUSTER.—Alt. 1675 m., *Rydberg* (1012, N; 1013, N), May 31 and June 6, 1892.

CUSTER PEAK.—About 3 miles E., alt. 1710 m., *Murdoch* (4365, M), foliage, September 8, 1910.

ELK CANON.—Alt. 1525 m., *Rydberg* (1016, N), June 2, 1892.

DEADWOOD.—Floodplain of Whitewood Creek, *Ball* (1351, B, N), foliage, 1908; (1680 and 1682, both B, C, N, R), foliage, 1910; (1829, B, N; 1830 [pistillate], B, N; 1831 [pistillate], B), foliage, 1913.

HOT SPRINGS.—Alt. 1100 m., *Rydberg* (1018, N), August 9, 1892.

REDFERN.—Plantation no. 2, alt. 1710–1740 m., *Murdoch* (4036 and 4037, F, M), flowers, May 13, 1910; (4219 and 4232, M), foliage, July 13, 1910.

ROCHFORD.—Alt. 1675–1830 m., *Rydberg* (1019, N), foliage, July 12, 1892.

12. *S. Geyeriana* Anderss.

BEAR BUTTE CREEK.—Alluvium, Sec. 19, Tp. 4 N., R. 4 E., alt. 1645 m., *Murdoch* (4367, M), foliage, September 9, 1910.

MERRITT.—Ranger Station, headwaters of Jim Creek, Sec. 8, Tp. 2 N., R. 5 E., alt. 1525 m., *Setzer* (F) 1912; (4, B), staminate flowers, May 6; leaves, June 2, 1913.

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